As illustrated in Figures 3 and 4, yoke 280 also transfers a closing force to clamp arm assembly 300 as pivoting handle portion 136 is moved toward instrument housing 130. Actuator travel stop 290 contacts pivot pin 153 at the bottom of the stroke of pivoting handle portion 136, stopping any further movement, or overtravel, of pivoting handle portion 136. Pawls 286 of yoke 280 transfer force to tubular collar 260 through a washer 151, a force limiting spring 155, and collar cap 152. Collar cap 152 is rigidly attached to tubular collar 260 after washer 151 and force limiting spring 155 have been assembled onto tubular collar 260 proximal to enlarged section 262. Collar cap 152 is illustrated in greater detail in Figures 5 and 6. Force limiting spring 155 is illustrated in greater detail in Figures 7 and 8, and washer 151 is illustrated in greater detail in Figures 9 and 10. Thickness of washer 151 may be adjusted during design or manufacturing of clamp coagulator 120 to alter the pre-load of force limiting spring 155. Collar cap 152 is attached to tubular collar 260 by ultrasonic welding, but may alternately be press fit, snap fit or attached with an adhesive.

Referring to Figures 5 through 10, tubular collar 260, a washer 151, force limiting spring 155, and collar cap 152 provide a force limiting feature to clamp arm assembly 300. As pivoting handle portion 136 is moved toward instrument housing 130, clamp arm assembly 300 is rotated toward ultrasonic blade 88. In order to provide both ultrasonic cutting, and hemostasis, it is desirable to limit the maximum force of clamp arm assembly 300 to 0.5 to 3.0 Lbs.

Figures 5 and 6 illustrate collar cap 152 including a spring surface 158. Figures 7 and 8 illustrate force limiting spring 155 including a cap surface 156, a washer surface 157, and a plurality of spring elements 159. Force limiting spring 155 is described in the art as a wave spring, due to the shape of spring elements 159. It is advantageous to use a wave spring for force limiting spring 155 because it provides a high spring rate in a small physical size well suited to an ultrasonic surgical instrument application where a central area is open for ultrasonic waveguide 179. Force limiting spring 155 is biased between spring surface 158 of collar cap 152 and spring face 165 of washer 151. Washer 151 includes a pawl

face 167 (Figures 9 and 10) that contacts pawls 286 of yoke 280 after assembly of clamp coagulator 120 (see Figures 2 through 4).

Referring now to Figure 2 and Figures 14 through 18, a rotational knob 190 is mounted on the elongated member 150 to turn the elongated member 150 so that the tubular collar 260 rotates with respect to the yoke 280. The rotational knob 190 may be fabricated from polycarbonate. The rotational knob 190 may also be made from a variety of materials including other plastics, such as a polyetherimide, nylon, or any other suitable material.

The rotational knob 190 preferably has an enlarged section or outer knob 192, an inner knob 194, and an axial bore 196 extending therethrough. Inner knob 194 includes keys 191 that attach cooperatively to keyways 189 of outer knob 192. The outer knob 192 includes alternating longitudinal ridges 197 and grooves 198 that facilitate the orientation of the rotational knob 190 and the elongated member 150 by a surgeon. The axial bore 196 of the rotational knob 190 is configured to snugly fit over the proximal end of the elongated member 150.

The inner knob 194 extends through an opening 139 in the distal end of the instrument housing 130. Inner knob 194 includes a channel 193 to rotatably attach inner knob 194 into opening 139. The inner knob 194 of the rotational knob 190 has a pair of opposing holes 199. The opposing holes 199 are aligned as part of a passageway 195 that extends through the elongated member 150, as will be described later.

A coupling member, such as, for example, pin 163, may be positioned through opposing holes 199 of the passageway 195. The pin 163 may be held in the passageway 195 of the elongated member 150 by any suitable means, such as, for example, trapped between ribs in housing 130, or a silicone or cyanoacrylate adhesive. The pin 163 allows rotational torque to be applied to the elongated member 150 from the rotational knob 190 in order to rotate the elongated member 150.

When the rotational knob 190 is rotated, the teeth 269 of the tubular collar 260 engage and ride up slightly on the corresponding pawls 286 of the yoke 280. As the pawls 286 ride up on the teeth 269, the supporting member 282 of the yoke 280 deflects outwardly to allow pawls 286 to slip or pass over the teeth 269 of the tubular collar 260.

In one embodiment, the teeth 269 of the tubular collar 260 are configured as ramps or wedges, and the pawls 286 of the yoke 280 are configured as posts. The teeth 269 of the tubular collar 260 and the pawls 286 of the yoke 280 may be reversed so that the teeth 269 of the tubular collar 260 are posts, and the pawls 286 of the yoke 280 are ramps or wedges. It is contemplated that the teeth 269 may be integrally formed or coupled directly to the periphery of the elongated member 150. It will also be recognized that the teeth 269 and the pawls 286 may be cooperating projections, wedges, cam surfaces, ratchet-like teeth, serrations, wedges, flanges, or the like which cooperate to allow the elongated member 150 to be indexed at selective angular positions, without departing from the spirit and scope of the invention.

As illustrated in Figure 2, the elongated member 150 of the clamp coagulator 120 extends from the instrument housing 130. As shown in Figures 2B through 4, the elongated member 150 preferably includes an outer member or outer tube 160, an inner member or inner tube 170, and a transmission component or ultrasonic waveguide 179.

The outer tube 160 of the elongated member 150 preferably includes a hub 162, a tubular member 164, and a longitudinal opening or aperture 166 extending therethrough. The outer tube 160 preferably has a substantially circular cross-section and may be fabricated from stainless steel. It will be recognized that the outer tube 160 may be constructed from any suitable material and may have any suitable cross-sectional shape.